

THE MINERAL INDUSTRY OF

GHANA

By Hendrik G. van Oss

Ghana's mineral industry has experienced a resurgence since the 1980's adoption of favorable investment and mining laws. A heavily mineralized country, Ghana is best known for its production of gold over the centuries. In 1994, Ghana was the second largest gold producer in Africa. It also was the third largest African producer of aluminum metal and manganese ore, and a significant producer of bauxite and diamonds. The country has become one of the largest world producers of byproduct arsenic. The above notwithstanding, Ghana's mineral industry remained subordinate to agriculture in overall importance to the economy. However, whereas once dominant cash crop exports, such as cocoa and timber, have declined due to poor world exports and frequent droughts, mining has grown in both relative and absolute terms. Gold became Ghana's single most valuable export in 1992 and has continued to be since.

Virtually all of Ghana's primary mineral production was exported, as was much of its secondary or value-added mineral output. In 1994, the reported value of exports of primary and secondary mineral commodities was about \$730 million, or almost 60% of total exports and equivalent to about 13% of the country's gross domestic product of \$5.42 billion.¹ Gold accounted for 75% of reported mineral commodity exports. Reported data excluded the value of smuggled gold and diamonds, estimates of which vary greatly. Cement was the main mineral commodity produced and largely consumed on the local market. Sales of cement in 1994 amounted to about \$100 million, and it was planned to expand production capacity.

Ghana's mineral commodity imports were dominated by petroleum products, alumina, fertilizers, and clinker. Imports of these are estimated to have totaled about \$350 million in 1994, or about 20% of total imports of goods.

In terms of economic importance, Ghana's geology is dominated by Precambrian rocks that cover the western one-half of the country. Of particular importance are lower Proterozoic greenstone belts made up of volcanic and sedimentary rocks of the Birimian Series. These rocks, and placers derived from them, host many of Ghana's gold deposits. The Birimian belts can have the gross form of synclinoria, some of which are cored by clastic rocks of the Tarkwaian Series, including important gold-bearing conglomerates similar to those of the Witwatersrand gold field in South Africa. Proterozoic granites intrude much of the Birimian, and near the Birimian gold belts some of these

granites are gold-bearing. Gold also is found and exploited in widespread placer deposits. In places, Birimian metasedimentary rocks contain alluvial diamonds, and erosion of these rocks is at least partly responsible for the formation of the modern placer deposits that are the basis of the country's diamond mining. Strongly altered and sheared diamond-bearing kimberlites recently discovered near Akwatia have yet to have their economic importance demonstrated. Birimian rocks also host the country's manganese deposits, and deep weathering of aluminous Birimian rocks has produced a number of bauxite deposits.

The southeast corner of the country is dominantly made up of lower Precambrian Dahomeyan gneisses and schists. The central and eastern one-third of the country is covered by horizontally bedded clastic sedimentary rocks of the upper Proterozoic to lower Paleozoic Voltaian System. These non-Birimian rocks are locally important as sources of industrial and construction rocks and minerals.

A great deal of exploration was ongoing during 1994 and more was planned for 1995, largely for gold and diamonds.

Government Policies and Programs

In the early 1980's, the Government began to enact policies to reverse an alarming decline in mineral production, particularly of gold. Restoration of the mining industry was a keystone of the ongoing general Economic Recovery Program (ERP), launched in 1983, and structured in consultation with the World Bank. A significant component of this program was the adoption of a new mining code, the Minerals and Mining Law 1986 (PNDCL 153). In addition to new mining legislation, the ERP sought to improve the general economy through a combination of improved investment laws, a relaxation of foreign exchange restrictions, and the privatization of the large state-owned industrial sector, including several mines. In 1994, the Government privatized the Ashanti gold mine, the country's largest, through the sale of 25% of the company.

Apart from the 1986 mining law, legislation affecting mining and mineral exploration in Ghana includes the Additional Profits Tax Law, 1985 (PNDCL 122); the Minerals Commission Law, 1986 (PNDCL 154); and the Minerals (Royalties) Regulations, 1987 (LI 1349). The Petroleum (Exploration and Production) Law, 1984 (PNDCL 84), controls petroleum-related activities. Regulation of

artisanal gold mining was set forth in the Small-Scale Gold Mining Law, 1989 (PNDCL 218). The Precious Minerals Marketing Corporation Law, 1989 (PNDCL 219), set up the Precious Minerals Marketing Corp. (PMMC) to promote the development of small-scale gold and diamond mining in Ghana and to purchase the output of such mining, either directly or through licensed buyers. The Minerals and Mining (Amendment) Act of 1994 reduced the 45% general mining corporate tax rate to 35%, the same as that imposed on other industries.

The Ministry of Lands and Natural Resources oversees all aspects of the Ghanaian mineral economy and is the grantor of mineral exploration and mining leases. Within the Ministry, the Minerals Commission has responsibility for recommending mineral policy, promoting mineral development, advising the Government on mineral matters, and serving as a liaison between industry and the Government. Geologic studies of Ghana are conducted by the Geological Survey Department; the Lands Commission maintains records of exploration licenses and mining leases; and the Mines Department has authority in mine safety matters. All mine accidents and other safety problems also must be reported to the Ghana Chamber of Mines, in which all mining companies operating in 1994 were members. The Chamber also provides information on Ghana's mining laws to the public and negotiates with the mine labor unions on behalf of its member companies. The Ministry of Fuel and Power formulates Ghanaian energy policy and issues licenses for petroleum and natural gas exploration in and offshore Ghana.

Mining and the associated growth of communities has led to locally severe deforestation, erosion, and water pollution. Where sulfide gold ores have been roasted, there has been air pollution from sulfur and arsenic oxide emissions. Arsenic recovery circuits have now been added to two of three processing plants producing it. Mercury to amalgamate gold is widely used by artisanal miners in Ghana and by a state-owned placer gold mine; artisanal usage in particular has led to mercury contamination of rivers. Until recently, environmental issues were not a high priority in Government planning but now all new mining operations are required to conduct and submit environmental impact studies and plan their operations to minimize environmental damage. Similarly, rehabilitation of existing mines now includes environmental planning. An Environmental Protection Agency was established in 1994 and draft guideline environmental regulations were issued. A portion of mining royalties are now directed to a fund to address some of the harmful effects of the mining industry, particularly the artisanal sector.

Production

Output of many of Ghana's major mineral commodities increased in 1994 (*See table 1*). Ghana's recorded gold

output in 1994 reached yet another record. Some artisanally produced gold was smuggled out of Ghana, but data were lacking for this commerce and estimates of its magnitude are not included in table 1. Arsenic trioxide production, a byproduct of gold ore smelting, declined significantly, owing to the shutdown of the roasting circuit at the smaller of the two mines having arsenic recovery units. Although bauxite production increased slightly, exports were up significantly owing to fewer bottlenecks in railing ore to the port and in shiploading of ore stockpiles. Recorded production of diamonds increased significantly, owing to processing plant rehabilitation at the sole formal mine and a presumed decline in the level of smuggling of artisanal output.

Power supply problems continued to beleaguer the country's aluminum smelter and metal production fell dramatically. Strong domestic demand led to increased cement output.

Trade

Except for construction materials, virtually all of Ghana's mineral production was exported. Crude or primary mineral exports in 1994 were worth about \$591 million. Gold was by far the most valuable primary mineral exported; sales in 1994 were worth about \$550 million. Official exports of diamonds were worth \$21 million. Bauxite exports during the year were worth about \$9.7 million and manganese ore exports were worth \$9.8 million. The true value of Ghana's diamond and gold exports was unknown because of smuggling; estimates of this commerce varied widely. Whereas the value of smuggled gold was likely only about 5% of reported sales, the value of smuggled diamonds probably was proportionately higher. A complicating factor was the fact that flow of diamonds and gold was both in and out of the country. In particular, Ghana appeared to be an entrepôt for smuggled diamonds produced elsewhere in Africa. This is based on the fact that, although most official diamond exports were to Belgium and/or India, U.S. customs data have in recent years included imports of stones directly from Ghana in the range of 200,000 to 950,000 carats per year, worth \$40 million to \$126 million. The overall and average per carat values of these stones are too high for the bulk of them to be Ghanaian production.

Ghana's main processed or secondary mineral commodity export was aluminum, which is toll-refined in Ghana from imported alumina. Aluminum exports in 1994 were worth about \$140 million, of which about \$50 million was the Ghanaian value-added component.

Ghana's mineral commodity imports were dominated by petroleum products, alumina, fertilizers, and clinker for cement. Imports of these are estimated to have totaled about \$350 million in 1994. Data on imports of mine and mill equipment, explosives, and reagents such as sodium cyanide were unavailable, but the value probably exceeded \$200 million for the year.

Structure of the Mineral Industry

Ghana's mineral industry in 1994 was dominated by primary mineral production, particularly of gold. Value-added mineral production was mostly of aluminum and cement. Through privatization programs, the Government has greatly reduced its once dominant stake in the cement and gold industries (*See table 2*). Negotiations to privatize the other mineral sectors were underway.

Commodity Review

Metals

Aluminum and Bauxite.--The Volta Aluminum Co. (VALCO) smelter, Ghana's sole producer of aluminum, had its lowest output since 1986 because of drought-induced power disruptions and rationing. In May 1994, VALCO reached agreement with the power company, the Volta River Authority (VRA), to reduce electricity consumption further through shutting down one smelter potline or 22% of operational capacity (30% of design capacity). In early September, citing critically low reservoir levels, VALCO suspended electricity exports to Bénin and Togo and informed VALCO that power to the smelter was to be cut off completely. However, VALCO and VRA arrived at an out-of-court settlement in which VALCO instead shut down another potline until mid-October, after which it would shut another one-half potline if water levels had not improved. Rains in October obviated the additional reduction and allowed the smelter to restart one potline in November; at yearend, the smelter was operating at 70% of design capacity.

Ghana's only bauxite mine to date is at Awaso, and produces chemical-grade ore for export to Europe. Bauxite storage and shiploading facilities at Takoradi have been expanded in recent years and could support mining well in excess of 500,000 mt/a if railroad capacity permitted. A proposal to add value to the ore by converting it locally to aluminum sulfate was made in 1994 by the mine's operating company, Ghana Bauxite Co. (GBC).

Gold.—Since 1983, gold output in Ghana has risen steadily; official output in 1993 exceeded 1 million troy ounces, or 31,104 kilograms (kg), for the first time and a further increase of 13.5% was registered in 1994. Although expansion projects at the Ashanti Mine have been responsible for much of these increases, a significant contribution also has come from new mines. With one new mine opening during 1994, a total of five major open pit mines have been opened from 1988 to 1994 (one has closed subsequently), as have a few small placer and/or tailings reprocessing operations. In 1994, these new mines contributed almost 30% of Ghana's total reported gold production. Apart from the formal mines, a significant

amount of gold was produced by artisanal miners. The true level of artisanal output was unknown because part of it was smuggled out of the country, mostly to Togo. There were nine formal gold mines in operation in Ghana in 1994, of which five accounted for 91% of the total recorded gold output of the country. These five mines were: Ashanti (60%), Teberebie (12%), Iduapriem (8%), Bogosu (8%), and Tarkwa (3%).

One of the richest gold mines in the world, the Ashanti Mine complex at Obuasi has, from startup in 1897 through yearend 1994, produced a total of about 726,550 kg of gold. Output in 1994 was 26,555 kg, the mine's highest calendar year performance ever and an 11.5% increase over the previous record, set in 1993. The mine exploits quartz and sulfide ores from a steeply dipping vein and shear zone system in Birimian rocks. Gold ore grades have averaged about 20 grams per metric ton (g/mt) gold for much of the mine's history, but have declined in recent years as the ratio of quartz to sulfide underground ore has decreased and as large quantities of lower grade surface ores and tailings have begun to be mined. In the 1993-94 fiscal year, for example, various ore types mined at Ashanti ranged in average gold grade from 10.49 g/mt to only 0.73 g/mt; overall, the mine averaged 3.26 g/mt.

The Ashanti Mine in 1994 was in the 10th year of a major program to expand production to an annual level of 31,103 kg by the 1995-96 fiscal year. Facets of the expansion program have evolved as new reserves were developed, new mining technologies and methodologies were adopted, and annual production targets were regularly exceeded. For much of its history, the mine has exploited only high-grade ore. A major component of the expansion program has involved accessing and efficiently mining large, relatively modest-grade underground sulfide and lesser quartz ore bodies found in the central and southern parts of the mine complex and low-grade surface extensions of the vein and shear zone complex. More recently, high-grade ore remnants in old pillars and stope backfill at the north end of the mine has been targeted. For the underground mine, shafts and winzes have been added or upgraded, bulk mechanized mining methods have been adopted, and rapid underground ore conveyance systems installed. The north-end high-grade ore has been accessed by a spiral ramp decline. For the Sansu project, a number of open pits have been developed. The old Pompora Treatment Plant (PTP) has been upgraded and several new treatment plants constructed, mostly to handle the Sansu surface ores and to retreat old tailings. Pollution controls have been added to the PTP, notably, in 1992, an arsenic trioxide scrubber.

A major development in 1994 was the January startup and April commissioning of the Sansu Sulfide Treatment Plant (STP), which is the world's largest bio-oxidation gold treatment facility. Bio-oxidation is an environmentally benign and relatively low-cost method of treating sulfide gold ores, especially those of too low a grade to justify the cost of

roasting or other oxidizing processes. The process can handle arsenopyritic (high-arsenic) ores. Originally intended to handle open pit sulfide ores, the STP also processed some underground material during the year. The STP's operational efficiency was above that expected, and the company decided it would add a fourth bio-oxidation circuit in 1995. Eventually, it was expected that the PTP roasting circuit would be phased out in favor of this new technology.

The Ashanti Mine had an active exploration project, both to upgrade existing reserves and to locate new areas of mineralization. Several prospects on vein systems parallel to the main shear zone were being explored and some ore, reportedly, was produced from mineralized granites on the mine concession. The ore potential of Tarkwaian conglomerates on the concession also was being tested. For the existing operations, total reserves for all ore classes, as of September 30, 1994, were listed by the company in its annual report as 91.1 million metric tons (Mmt) grading 6.7 g/mt gold. Underground ores made up 72% of the reserves (contained gold); open pit ores, 22%; and tailings the rest.

The Government has for years owned 55% of the Ashanti Mine. In late April 1994, the Government put 25% of the mine up for sale. About 95% of the listing was on the London Stock Exchange, the remainder on the Accra Exchange. Lonrho Plc., the mine operator and hitherto 45%-owner agreed not to increase its own holdings. Lonrho was left as the majority stakeholder, albeit with a slightly reduced percentage holding because of its issuance of a small number of new shares.

The Bogosu and Prestea Mines are geologically similar to, but much smaller and less rich than, the Ashanti Mine. The Bogosu Mine, acquired by Gencor Ltd. of South Africa in 1994 through its purchase of Billiton International Metals B.V. of the Netherlands in 1994, is an open pit operation exploiting very limited oxide ores and substantial sulfide ores remaining from an earlier open pit operation (the Marlu Mine). Sulfide ores at Bogosu, like the Ashanti Mine, are high in arsenic and the mine has an arsenic scrubber on its roaster. Bogosu's milling and/or roasting circuits have been plagued by technical problems since the mine's startup, necessitating a brief shutdown of the fluidized bed roaster in mid-1993 and its complete shutdown for virtually all of 1994. The arsenic trioxide entry for the year in table 1 reflects this. The roaster shutdown notwithstanding, the mine was able to process sufficient oxide ores to achieve a 15% increase in gold output during the year, to 3,392 kg. Reserve data at yearend were unavailable.

The Prestea Mine had another poor year, with gold output falling 6.5% to just 612 kg. This old underground mine was operated by the State Gold Mining Corp. (SGMC), although negotiations were underway to privatize the operation. The mine complex was in need of extensive rehabilitation of the underground workings and of the antiquated mill. A great deal of reserve delineation drilling was needed to determine the feasibility of this rehabilitation. The mine was considered

to be greatly overstaffed. Investor interest in the mine was mainly in the gold resources contained in old dumps and tailings and in the open pit potential of the concession. Privatization of the Prestea Mine complex has been complicated by the Government's apparent splitting of the property. Prestea Sankofa Gold Ltd., a joint venture of SAMAX Resources Ltd. of the United Kingdom (50.4%), Ghana National Petroleum Co. (39.6%), and the Government (10%), was granted a multiyear lease to the Prestea tailings and dumps in early 1994. SAMAX was also seeking rights to the rest of the property. However, Johannesburg Consolidated Investment Co. Ltd. of South Africa reportedly was negotiating an option on the existing mining operation and on the concession's remaining lode gold resources. The ultimate disposition of the mine remained uncertain at yearend. In the meantime, SAMAX ordered a processing plant, complete with a 320,000 mt/a CIL circuit, for tailings retreatment; commissioning was expected in May 1995.

The Teberebie, Iduapriem, and Tarkwa Mines, operating on adjacent concessions near Tarkwa, all exploited Tarkwaian conglomerate ore. All three operations were much simpler geologically and metallurgically than the Ashanti Mine. The Teberebie Mine, an open pit operation, processed ore by conventional heap leaching, whereas Iduapriem, also an open pit mine, used milling plus carbon-in-leach (CIL) processing; and the underground Tarkwa Mine relied mostly on a gravity recovery circuit.

The Teberebie Mine, Ghana's second most productive, increased its output in 1994 by 7.5% to 5,514 kg. The mine commissioned its second open pit and heap leach during the year, pouring its first gold from the new facility in July. The feasibility of constructing a third open pit and heap leach complex was being studied, as was the possibility of installing conventional milling and cyanidation circuits for part of the ore. Total gold output for Teberebie in 1995 was targeted at about 8,250 kg. Reserves at yearend 1994 were published by the company as about 208,400 kg of contained gold.

Adjacent to Teberebie, the Iduapriem Mine had its second full year of operation in 1994. Gold output dropped 3.8% to 3,689 kg, reportedly because of some technical problems at the recovery plant. This notwithstanding, the mine was Ghana's third largest gold producer. Like Teberebie, it was planned to expand production, largely through a second open pit, to be constructed on the adjacent Ajopa concession. Proven plus probable reserves at midyear 1993 were given by the company as totaling 53,100 kg of recoverable gold, with a similar amount as resources. Although data were incomplete, reports of infill drilling in 1994 indicate that resources have been increased by about 30%, mostly in the reserve categories.

The Tarkwa Mine was the first active gold mine to be privatized in Ghana and has been operated by Gold Fields of South Africa since mid-1993. Efforts have been made to make the old underground mine more efficient through the

introduction of new equipment and rationalization of the workforce. Ore reserve delineation has been a priority, both for the existing mine and to delineate near surface ores for open pit mining. The mine was plagued with labor problems during the year, particularly from July on, and managed an output of 1,225 kg, only slightly higher than that in 1993. Exploration work was more successful. The company reported that a drilling program had outlined several potential open pit ore bodies with total potentially economic resources of about 170,000 kg of gold. A prefeasibility study of these prospects was to be conducted in early 1995. Underground reserves and resources were given by the mine's minority shareholder, Mutual Resources Ltd., as approximately 18,000 kg, although this likely included material in old support and shaft pillars as shown in old company reports.

Construction of Cluff Resources Plc.'s Ayanfuri Mine was completed in October 1994 and the mine had its first gold pour in November. The mine produced 139 kg of gold by yearend and was expected to produce about 1,000 kg in 1995; commissioning was scheduled for May 1995. Mineralization at Ayanfuri is unusual for Ghana in that the gold is found both in weathered granitic rocks and the immediately adjacent Birimian metasediments. The gold can occur free, associated with iron oxides, or associated with sulfide minerals. Both sulfide and oxide gold resources have been delineated, but the current mine is based solely on oxide ore.

Proven and probable open pit oxide reserves, according to Cluff, amount to 6.06 Mmt having a gold grade of 1.68 g/mt.

A number of advanced gold projects were underway during the year. Financing was obtained to reopen the Southern Cross Mine (closed in 1992) at Obenemase, near Konongo, under new ownership and production was expected to resume in early 1995. Work was underway to open a mine on the old Abooso concession near Tarkwa; exploration work has identified resources in Tarkwaian conglomerates, in sheeted quartz veins in overlying laterites, and in old tailings and dumps. Several companies were exploring concessions in the Bibiani greenstone belt, particularly that part from Bibiani southwest to the Côte d'Ivoire border. The largest project was at the Bibiani Mine area itself, where International Gold Resources Corp. of Canada conducted extensive drilling during the year and was planning more drilling and a feasibility study in 1995. A number of Canadian companies were jointly funding a major airborne magnetic, radiometric, and electromagnetic geophysical survey of south-western Ghana, covering the main gold belts.

Manganese.—The Nsuta Mine has been the only significant producer of manganese ore in Ghana and has been worked since 1916. The mine produces both oxide and carbonate ores, as well as a transitional ore referred to as "Carbox." Output of processed oxide ore in 1994 was 92,562 mt, a 30% decline from 1993 levels that reflected, in part, diminished reserves. Processed carbonate (including Carbox)

ore output declined only slightly, to 172,135 mt. Except for a few hundred tons of battery grade oxide ore sold to local battery companies and very small amounts sold to gold processing plants, all of the mine's ore sales were exports. Exports in 1994 amounted to 245,423 mt—a decrease of almost 18%. Recent modifications to the washing plant have allowed the processing of hitherto waste Carbox fines to a salable product and this material made up about 12% of exports in 1993; data for 1994 were unavailable. In 1993, the mine reported having stockpiles of "waste" Carbox fines amounting to almost 0.5 Mmt; this material, if processed, could become an important resource, especially in light of reduced availability of new oxide ore.

Likewise, the mine can now process hitherto stockpiled chemical-grade oxide fines to salable metallurgical-grade. Apart from unfavorable world manganese ore prices, the Nsuta Mine's total production also has been constrained by limited raiiling capacity; the railroad is shared with the Awaso bauxite mine.

The Government was negotiating with international manganese companies interested in purchasing the Nsuta Mine and its concession. The negotiations were complicated by the fact that the concession was also of exploration interest for gold.

Industrial Minerals

Diamonds.—Following years of declining production, deterioration of plant facilities, exhaustion of traditional reserves, and higher mining costs associated with more distant reserves, the Government, in 1990, began seeking buyers for the Akwatia diamond mine. In late 1991, it was announced that an 80% stake in the mine would be sold to a joint venture between Lazare Kaplan International (LKI) of the United States and Inco Ltd. of Canada. When Inco dropped out of the venture in early 1993, LKI continued to market the diamonds (hitherto sold to the PMMC) while another operating partner was sought. In late 1993, it was announced that the Parliament had approved a joint-venture option agreement between LKI and De Beers Centenary AG of Switzerland. A new company, Birim River Diamond Ltd (BRD), was to be formed with LKI and De Beers each having 40% and the Government, 20%. As part of the option, De Beers, in early 1994, entered into an 18-month contract to rehabilitate the existing mill, manage the mine, market the diamonds, and do sufficient additional bulk sampling for a feasibility study. This work was conducted in 1994; work at the mill consolidated the two existing plants into one and installed a heavy-media separation circuit. This helped the mine increase production significantly in 1994, although reported output may have included a significant contribution from licensed artisanal "tribute" miners working the margins of the property. The results of the feasibility study were expected by mid-1995.

Apart from Akwatia, diamond production in Ghana during the year was from widespread artisanal workings. The true level of artisanal output was unknown because of smuggling.

Except for sales to De Beers, legal sales of artisanal output were to the PMMC, which recorded a modest increase in purchases during the year, probably because of a more generous pricing policy. Accordingly, it was estimated that the level of smuggling declined somewhat and the entry in table 1 reflects this.

Several Canadian companies continued with diamond exploration in the general Akwatia area. Most work targeted placer deposits but one company was also evaluating newly-discovered metakimberlites on its concession.

Limestone.—A new company, Limestone Products (Ghana) Ltd., was formed during the year to supply limestone and lime to the gold mining industry and for water treatment. The company's facility, near Takoradi, would have storage for imported lime and limestone, and would have limestone crushing and lime processing facilities. It was expected that some local deposits of sea shells also would be processed, and a nearby limestone deposit was being examined as a feed source. The prime customer for the company was its 51%-owner, Ashanti Goldfields, which required both lime and limestone for its biooxidation gold recovery circuit.

Reserves

GBC claimed that it has access to bauxite reserves sufficient to support a mine life of 100 years. Mining plans call for an increase in output to 500,000 mt/a, eventually to be doubled. As reported by the director of the Ghana Geological Survey Department,² Ghana has significant reserves outside the Awaso area, namely about 60 km west of Kumasi, and those near Kibi. These have been extensively drill sampled. The deposits near Kumasi have an inventory totaling 278 Mmt grading 48.9% to 51% alumina and 2.8% to 4.4% silica. The Kibi area bauxite resource totals 120 Mmt grading 40.8% to 45.7% alumina and 1.8% to 3.9% silica.

Ghana has large gold resources, although summation of them is complicated by the different reserve reporting methods used by various companies. Published data from the existing mines and for certain advanced projects indicate a total defined Ghanaian resource for yearend 1994 in the range of 1,300 to 1,500 mt of contained gold. The Ashanti Mine had about 45% of this inventory. Ghana's total gold resources are undoubtedly larger than this, based on the known extent of host rocks, the widespread artisanal production of gold, and the existence of a number of closed old mines, many of which shut down without having depleted their gold resources and which have not yet been re-evaluated.

The only large established manganese reserves in Ghana are at the Nsuta Mine, although several other deposits are known. Current ore reserves at the Nsuta Mine have not been published, although it is believed that the mine has reserves of oxide ore of approximately 0.4 Mmt, sufficient for about 4 more years of production at 1994 levels. Remaining reserves of carbonate ore are likely to be adequate for 50 to

60 years of production at current levels.

Ghana's diamond resources are large, based on known reserves at the Akwatia Mine and the widespread artisanal production of diamonds. The Akwatia Mine's remaining reserves are virtually all in gravels along the Birim River. Proven reserves in these gravels delineated by the United Nations (UN) during a drilling program from 1980 to 1983, according to the company, amounted to about 15 million cubic meters grading about 1.1 carats per cubic meter. Subsequent drilling by the mine has increased this inventory substantially and it was believed that the true resources were about double those determined by the UN. Kimberlites now have been found in the area, but the potential diamond resources therein have yet to be ascertained.

Ghana's oil and gas resources are not well known, although recent drilling programs have tested resources in a couple of fields. Published data are contradictory, for both fuels. However, natural gas reserves in the North and South Tano Fields were believed adequate to supply a thermal powerplant to be constructed along the western coast.

Infrastructure

Ghana's road infrastructure is concentrated in the south and southwestern part of the country. Apart from some of the main roads, much of the country's road network in 1994 remained in poor condition, unsuitable for transport of bulk mineral commodities. Ghana's railroad infrastructure remained in poor condition except for rehabilitated sections of the western line. This line is the export route for the country's manganese ore and bauxite and serves the major gold-producing area.

Ghana's major ports are Takoradi and Tema. All of the country's manganese ore and bauxite shipments are through Takoradi. Tema handles the needs of the VALCO aluminum smelter, and both ports handle imports of clinker for cement.

In 1994, Ghana's electrical generating capacity remained about 1,185 megawatts (MW), of which 1,072 MW was from hydropower. Because of greatly reduced water levels in the reservoirs, power disruptions and rationing were common throughout 1994 and electricity exports were terminated.

¹Where necessary, values have been converted from Ghanaian cedis (C) to U.S. dollars at the rate of C956.6=US\$1.00.

²Kesse, G. O. *The Mineral and Rock Resources of Ghana*; A.A. Balkema, Rotterdam, 1985, 610 pp.

Other Sources of Information

Geological Survey Department
P.O. Box M.80
Accra, Ghana
Minerals Commission
P.O. Box M. 248
Accra, Ghana
Fax: 233-21-773-324

TABLE 1
GHANA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

Commodity 3/	1990	1991	1992	1993 e/	1994 e/	
Aluminum:						
Bauxite:						
Gross weight	thousand metric tons	381	353 /e	338	424 4/	426 4/
Sales	do.	369	324	399	365 4/	452 4/
Metal, smelter, primary	do.	174	175	180	175 4/	141 4/
Arsenic, trioxide e/	metric tons	--	500	4,500 e/	9,000	8,000
Cement, hydraulic 5/	thousand metric tons	675	750	1,020	1,200 4/	1,350 4/
Diamond: e/						
Gem	thousand carats	520	560	570	570	640
Industrial	do.	130	140	140	140	160
Total 6/	do.	650	700	710	710	800
Gold 7/	kilograms	16,800	26,300	31,000	39,200 4/	44,500 4/
Manganese:						
Ore, processed	thousand metric tons	247	326 r/	353 r/	295	265 4/
Mn content e/	do.	96	122 r/	133 r/	115	101
Petroleum, refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	186 r/	186 r/	197 r/	40 r/	200
Gasoline	do.	1,730	1,790	1,800 r/	325 r/	1,800
Jet fuel	do.	384 r/	376 r/	384 r/	100 r/	400
Kerosene	do.	915	760 r/	798 r/	200 r/	800
Distillate fuel oil	do.	1,530	1,570	1,580 r/	400	1,600
Residual fuel oil	do.	1,860 r/	1,870 r/	1,900 r/	475 r/	1,900
Other e/	do.	465 r/	479 r/	449 r/	115 r/	450
Refinery fuel and losses e/	do.	280	300	350 r/	90 r/	350
Total e/	do.	7,350 r/	7,330 r/	7,460 r/	1,750 r/ 8/	7,500
Salt e/	thousand metric tons	50	50	50	50	50
Silver, content of gold ore e/	kilograms	840	1,320	1,550	1,960	2,230
Steel, crude e/	thousand metric tons	26	27	25	25	25

e/ Estimated. r/ Revised.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant figures; may not add to totals shown.

2/ Table includes data available through June 23, 1995.

3/ In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) are produced, as is limestone for processing of some gold ore. There was some small test production of crude petroleum in 1992. Output of these commodities is not reported and information is inadequate to make reliable estimates of output levels.

4/ Reported figure.

5/ All from imported clinker.

6/ Production, in thousand carats, includes that of Akwatia Mine (1990--152; 1991--146; 1992--214; 1993--214; 1994--356), PMMC purchases of artisanal production (1990--485; 1991--542; 1992--480; 1993--376; 1994--406); and estimates of smuggled artisanal production.

7/ Does not include estimate of smuggled production.

8/ Refinery was reported closed for maintenance for much of the year.

TABLE 2.
GHANA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1994

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum	thousand metric tons	Volta Aluminum Co. Ltd. (VALCO) (Kaiser Aluminum & Chemical Corp., 90%; Reynolds Metals Corp., 10%)	Aluminum smelter at Tema	200. 1/
Bauxite	do.	Ghana Bauxite Co. Ltd. (Government, 55%; British Alcan Chemicals Ltd., United Kingdom, 45%)	Bauxite mine at Awaso	500.
Cement	do.	Ghana Cement Works Ltd. (Scancem International ANS, Norway, 59.5%, Government, 40%; other, 0.5%)	Clinker grinding plant at: Takoradi Tema	400. 700.
Diamond	thousand carats	Ghana Consolidated Diamonds Ltd. (Government, 100%)	Placer mine at Akwatia	360. e/
Gold	kilograms	Ashanti Goldfields Co. Ltd. (Lonrho Plc., United Kingdom, 43.0%; Government, 29.9%; other private, 27.1%)	Underground and surface mine at Obuasi	31,100.
Do.	do.	Billiton Bogosu Gold Ltd. (Billiton International Metals B.V., 2/ Netherlands, 81%; IFC, 9%; Government, 10%)	Open pit mine at Bogosu	3,400. e/
Do.	do.	Bonte Gold Mining Ltd. (Akrokeri-Ashanti Gold Mines, Inc., Canada, 85%; Government, 10%; Buosiako Co. Ltd., Ghana, 5%)	Placer mine at Esase, about 40 kilometers southwest of Kumasi	625. e/
Do.	do.	Cluff Mining Ghana (Cluff Resources Plc., United Kingdom, 75%)	Ayanfuri Mine, 15 kilometers west of Dunkwa	1,100. e/
Do.	do.	Ghana Australian Goldfields Ltd. (Golden Shamrock Mines, Ltd., Australia, 68.95%; Government, 20%; IFC, 10%; private share- holders, 1.05%)	Iduapriem open pit mine near Tarkwa	4,050.
Do.	do.	Gold Fields Ghana Ltd. (Gold Fields of South Africa, 85%; Government, 10%; Mutual Resources Ltd., Canada, 5%)	Underground mine at Tarkwa	1,500.
Do.	do.	State Gold Mining Corp. (Government, 100%) ^{3/}	5 gold dredges near Dunkwa	200.
Do.	do.	do.	Underground mine at Prestea	620. e/
Do.	do.	Teberebie Goldfields Ltd. (Pioneer Group Inc., United States, 90%; Government, 10%)	Open pit mine near Tarkwa	8,000. e/
Manganese ore	thousand metric tons	Ghana National Manganese Corp. (Government, 100%)	Open pit mine at Nsuta	400 e/ (processed ore).
Steel	do.	Steelworks Co. subsidiary of Ghana Industrial Holdings Co. (Government, 100%)	Steel mill at Tema	2.5 (rebar).
Do.	do.	Wahome Steel Ltd. (private Taiwanese investors, 95%; Ghanaian investor, 5%)	do.	30 (rod, rebar, and wire).
Petroleum products	thousand barrels	Tema Oil Refinery (Government, 100%)	Refinery at Tema	10,600 (crude input).

e/ Estimated.

1/ Based on five potlines. Operational capacity at yearend 1994 was 70%.

2/ Billiton was purchased by Gencor Ltd. of South Africa in 1994.

3/ The Government was privatizing the mines.